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Indian Standard

ELECTROTECHNICAL VOCABULARY

PART IV ELECTRON TUBES

Section I Common Terms

(First Revision)

(First Reprint OCTOBER 1984)

UDC 001·4 : 621·385

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 7

October 1974

Indian Standard
ELECTROTECHNICAL VOCABULARY
PART IV ELECTRON TUBES
Section 1 Common Terms
(First Revision)

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(*Continued on page* 2)

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(*Continued on page* 24)

Indian Standard

ELECTROTECHNICAL VOCABULARY

PART IV ELECTRON TUBES

Section I Common Terms

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part IV/Sec 1) (First Revision) was adopted by the Indian Standards Institution on 14 November 1973, after the draft finalized by the Electrotechnical Standards Sectional Committee in consultation with the Electron Tubes Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard was first published in 1965 to cover terms and definitions relating to receiving tubes only. As most of the terms covered in the original version were applicable to other types of tubes also, it was decided at the time of revision of this standard to modify the scope to cover the terms and definitions common to all types of tubes. In consonance with the modified scope, the title has also been modified.

0.3 In preparing this standard, assistance has been derived from IEC document 1 (IEV 531) (Central Office) 1031 Draft revision of IEV Chapter 07 ' Electronic tubes ' issued by the International Electrotechnical Commission.

0.4 This standard is one of a series of Indian Standards on electrotechnical vocabulary. A list of standards published so far in the series is given on pages 25-26.

1. SCOPE

1.1 This standard (Part IV/Sec 1) covers definitions of terms common to all types of electron tubes.

2. GENERAL TUBE CLASSIFICATION

2.1 Electron Device — A device in which conduction is principally by electrons moving through vacuum, gas or semiconductor.

2.2 Electron Tube — An electron device in which conduction takes place by electrons or ions between electrodes through vacuum or gaseous medium within a gastight envelope, but excluding devices used only for lighting.

NOTE — The term ' tube ' is commonly used in the field of electronics for convenience conveying the same meaning as ' electron tube '.

2.3 Vacuum Tube — An electron tube evacuated to such a degree that its electrical characteristics are essentially unaffected by the ionization of any residual gas or vapour.

2.4 Electron Beam Tube — An electron tube the performance of which depends on the formation and control of one or more electron beams.

2.5 Gas-Filled Tube — An electron tube in which the electrical characteristics are substantially established by the ionization of deliberately introduced gas or vapour.

3. EMISSION AND SPACE CHARGE

3.1 Electron Emission — The liberation of electrons from a surface into the surrounding space.

3.2 Emission Current — The current resulting from electron emission.

3.3 Specific Emission — The rate of electron emission per unit area.

3.4 Work Function (of an Electrode Material) — The minimum energy required for the removal to infinity of an electron initially at the fermi level.

3.5 Contact Potential Difference — The difference between the work functions of two materials, divided by the elementary charge.

3.6 Thermionic Emission — The electron emission caused solely by the temperature of the electrode.

3.7 Photoelectric Emission — The electron emission caused due to incident radiation.

3.8 Field Emission — The electron emission caused solely by an electric field.

3.9 Primary Electron Emission — The thermionic, photoelectric or field emission of electrons.

3.10 Secondary Electron Emission — The electron emission caused directly by bombardment of a surface by electrons or ions.

3.11 Secondary Electron Emission Current — The current resulting from secondary electron emission and reflection of incident primary electrons.

3.12 Secondary Electron Emission Factor — The ratio between the secondary electron emission current and the primary electron current.

3.13 Thermionic Emission Efficiency — The ratio between the saturation thermionic emission current and the heating power of the cathode.

3.14 Schottky Effect — The increase of thermionic or photoelectric emission, relative to the field-free emission, caused by an accelerating electric field at the surface of the cathode.

3.15 Cathode Interface Layer — An undesired poorly conducting layer between the base metal and the coating of an oxide-coated cathode.

3.16 Space Charge — The electrical charge in a region of space due to the presence of electrons or ions or both.

3.17 Space Charge State — The state of operation in which the presence of a negative potential minimum in front of the cathode causes the emission current to be largely independent of the cathode temperature.

3.18 Saturation State — The state of operation in which the cathode current is limited only by the emitting capability of the cathode.

3.19 Field-Free Emission Current — The emission current from a cathode when the electric field at the surface is zero.

3.20 Residual State — The state of operation of an electron tube in the absence of an accelerating field from the anode of a diode or equivalent diode, in which the cathode current is due to the initial velocity of emission of electron.

3.21 Saturation Current — The value of the current in the saturation state.

4. TUBE NOISE — *See* IS : 1885 (Part IV/Sec 6)-1972*.

5. CURRENT, VOLTAGE AND POWER

5.1 Electrode Voltage — The voltage between an electrode and a stated reference point usually on the cathode.

Note — Unless otherwise stated, an electrode voltage is measured at the available terminals.

5.2 Supply Voltage — The voltage, excluding signal voltage, applied to the circuit of an electrode by an external source.

5.3 Electrode Current — The net value of the current passing to or from an electrode through the interelectrode space.

Note 1 — The terms 'cathode current', 'grid current', 'anode current', etc, are used to designate electrode currents for these specific electrodes.

Note 2 — Unless otherwise stated, electrode current is measured at an available terminal.

5.4 Electrode Dissipation — The power dissipated in an electrode in the form of heat as a result of bombardment by electrons or ions or both.

5.5 Reverse Electrode Current/Inverse Electrode Current — The current flowing through an electrode in the direction opposite to that for which electron tube is designed.

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*Electrotechnical vocabulary: Part IV Electron tubes, Section 6 Noise in microwave tubes.

5.6 Surge Current of an Electrode — The peak electrode current under exceptional conditions, such as switching-on conditions or fault conditions.

5.7 Saturation Voltage — That voltage above which there is no significant change in the cathode current when the voltage is increased.

5.8 Filament Voltage — The voltage between the terminals of the filament.

5.9 Filament Current — The current in a filament lead under stated conditions.

5.10 Heater Voltage — The voltage between the terminals of the heater.

5.11 Heater-Cathode Voltage — The voltage between one terminal of the heater and the cathode terminal or between the centre tap of the heater transformer and the cathode.

5.12 Heater Current — The current through the heater under stated conditions.

5.13 Filament (or Heater) Starting (Surge) Current — The peak value of the filament (or heater) current resulting from the application of the filament (or heater) voltage under stated conditions.

5.14 Leakage Current — A conduction current which flows between two or more electrodes by any path other than across the vacuous space between the electrodes.

5.15 Heater-Cathode Insulation Current/Heater-Cathode Current — The current between the heater and the cathode, when these have a potential difference.

NOTE — The term includes leakage current and any current caused by electron emission from the heater and the cathode.

5.16 Cathode Current — *See* 5.3.

5.17 Grid Current — The total current in the terminal of the grid of a tube. The grid current is defined as being positive when the flow of electrons is from the grid terminal to the external circuit.

5.18 Cut-Off Voltage — That electrode voltage which reduces the value of a dependent variable, for example, anode current, to a stated low value.

5.19 Grid Bias Voltage — The average value of the grid voltage, under stated conditions, which determines the operating point.

5.20 Grid Input Voltage — The varying voltage applied to a control grid.

5.21 Grid Input Power — The product of instantaneous components of the alternating grid input current and voltage averaged over a complete cycle.

5.21.1 *Driving Power/RF Input Power* — The radio frequency power delivered to the amplifier tube at the input terminal or input reference plane.

5.22 Anode Supply Power — The dc power supplied to the anode by the supply source under stated conditions.

5.23 Output Power — The total power transferred from the electron tube to the output circuit.

5.24 Peak Forward Anode Voltage — The maximum instantaneous positive anode-to-cathode voltage.

5.25 Peak Negative Anode Voltage — The maximum instantaneous negative anode-to-cathode voltage.

5.26 Tube Voltage Drop — The anode-cathode voltage during conduction.

5.27 Gas Current — An unwanted ion current resulting from collisions between electrons and residual gas molecules in a vacuum tube.

5.28 Flashover Voltage — The voltage at which arcing or discharge occurs caused by a breakdown between two or more electrodes.

5.29 Load Current — The output current of an electron tube utilized in an external load circuit.

5.30 Quiescent Current — The electrode current corresponding to the electrode bias voltage.

6. ELECTRICAL QUANTITIES AND PROPERTIES (OTHER THAN CURRENT, VOLTAGE AND POWER)

6.1 Electrode Impedance — At a stated operating point and frequency, the ratio between the fundamental frequency component of the voltage at the accessible terminal of an electrode and the sinusoidal current applied to that terminal to cause that voltage, all other electrode voltages being maintained constant.

NOTE — For infinitesimal amplitude, this is the reciprocal of the electrode admittance (*see* **6.4**).

6.2 Input Impedance — The input electrode impedance.

6.3 Output Impedance — The output electrode impedance.

6.4 Electrode Admittance — At a stated operating point and frequency, the ratio between the fundamental frequency component of the current into the accessible terminal of an electrode and the sinusoidal voltage applied to that terminal to cause the current, all other electrode voltages being maintained constant.

NOTE — For infinitesimal amplitude, this is the reciprocal of electrode impedance (*see* **6.1**).

6.5 Input Admittance — The input electrode admittance.

6.6 Output Admittance — The output electrode admittance.

6.7 Electrode Reactance — The imaginary component of electrode impedance.

6.8 Electrode AC Resistance — The real component of electrode impedance.

6.9 Electrode DC Resistance — At a stated operating point, the ratio between the direct electrode voltage and the direct electrode current.

6.10 Electrode Conductance — The real component of electrode admittance.

6.11 Electrode Susceptance — The imaginary component of electrode admittance.

6.12 Transadmittance — At a stated operating point and frequency, the ratio between the fundamental frequency component of the short-circuit current into the accessible terminal of an electrode and the sinusoidal voltage applied to the terminal of another electrode to cause the current, all other electrode voltages being maintained constant.

6.13 Transconductance — The real component of the transadmittance.

6.14 Mutual Conductance — The transconductance between the output electrode and the control electrode.

6.15 Conversion Transconductance — Under stated operating conditions, the ratio between a stated single frequency component of the short-circuit current through the output terminal and the sinusoidal voltage of different frequency (not an integral multiple) applied to the input terminal to cause the output current, all other electrode voltages being maintained constant.

6.16 Interelectrode Capacitance — The capacitance between stated electrodes or groups of electrodes under stated conditions.

6.17 Diode Perveance — The ratio between the space-charge-limited cathode current and the three-halves power of the anode voltage.

6.18 Anode Efficiency — The ratio between the ac power delivered to the load and the anode supply power.

6.19 Anode AC Resistance — The real component of the anode impedance.

6.20 Vacuum Factor/Gas-Content Factor — The ratio between the gas current and the electron current that causes it.

6.21 Voltage Factor/Mu Factor — The ratio between the infinitesimal change in one electrode voltage and the change in another electrode voltage required to maintain a stated electrode current unchanged, all other electrode voltages being maintained constant.

6.22 Amplification Factor — The voltage factor or mu factor for a stated electrode and the central electrode, the anode current being maintained constant.

6.23 Power Gain — The ratio, usually expressed in decibels, between the output power of an amplifier tube operated under stated conditions and the driving power.

6.24 Incremental Power Gain — The ratio between the increase in the output power and a small increment of the driving power causing it.

6.25 Input Capacitance — The sum of the direct capacitances between the control electrode (usually the grid) on the one hand and the cathode and all other electrodes connected to it on the other.

6.26 Output Capacitance — The sum of the direct capacitances between the output electrode on the one hand and the cathode and all other electrodes connected to it on the other.

6.27 Anode-Grid Capacitance — The capacitance between the anode and the grid, all other electrodes and shields being held at earth potential.

6.28 Grid-to-Grid Capacitance — The capacitance between two grids, all other electrodes and shields being held at earth potential.

6.29 Heater-Cathode Capacitance — The capacitance between the cathode and the heater, all other electrodes and shields being held at earth potential.

6.30 Effective Input Capacitance — The coefficient of $J\omega$ in the complex expression for the input admittance.

6.31 Effective Output Capacitance — The coefficient of $J\omega$ in the complex expression for the output admittance.

7. CHARACTERISTICS AND CONDITIONS OF OPERATION

7.1 Characteristic — The relation, usually shown by a graph, between two quantities under stated operating conditions.

7.2 Electrode Characteristic — The relation, usually shown by a graph, between the current and voltage of an electrode, all other operating conditions being maintained constant.

7.3 Dynamic Characteristic — An electrode characteristic for which the relevant quantities are varying with time.

7.4 Static Characteristic — An electrode characteristic for which the relevant quantities have only dc values.

7.5 Transfer Characteristic/Mutual Characteristic — An electrode characteristic relating to the current or voltage of one electrode and the current or voltage of another electrode, all other electrode voltages being maintained constant.

7.6 Forward Direction — The direction of continuous (direct) current flow in which the electrode dc resistance is the lowest.

7.7 Reverse Direction — The direction of continuous (direct) current flow in which the electrode dc resistance is the highest.

7.8 Diode Characteristic/Emission Characteristic of Multi-electrode Tube — The relation, usually shown by a graph, between the current of the cathode and any electrode (s) connected internally to it and the voltage applied between the cathode and all other electrodes connected together.

7.9 Load — That part of the circuit which lies beyond the output terminal.

7.10 Load Impedance — The total impedance of the external circuit between the output electrodes.

7.11 Operating Line/Operating Curve — The locus of all simultaneous values of total instantaneous electrode voltage and current for given external circuit conditions.

7.12 Load Line — An operating line for currents and voltages of the output electrode for a fixed value of load impedance.

7.13 Operating Point/Working Point — The point on the family of the characteristic curves corresponding to the average voltages or currents of the electrodes.

7.14 Instantaneous Operating Point — The point on an operating line corresponding to the total instantaneous simultaneous voltage and current of an electrode.

7.15 Duty Factor — The ratio between the sum of pulse durations and a stated averaging time. For repetitive phenomena, the averaging time is the pulse repetition period.

7.16 Cold Conditions — The conditions in which no supply voltage(s) is (are) applied to the tube.

7.17 Standby Conditions — The conditions in which the heater or filament voltage only is applied to the tube.

7.18 Operating Conditions/Hot Conditions — The conditions in which all supply voltages and, where appropriate, signals are applied to the tube.

7.19 Class A Operation — The operation of an electron tube in such a way that the output current flows for the whole of the electrical cycle when a pure sinusoidal input signal is used.

Note — The suffix '1' to 'A' may be used to denote that the input current does not flow.

The suffix '2' may be used to denote that the input current flows during some part of the cycle.

7.20 Class AB Operation — The operation of an electron tube in such a way that the output current flows for appreciably more than half but for less than the whole of the electrical cycle when a pure sinusoidal input signal is used.

Note — The suffix '1' to 'AB' may be used to denote that the input current does not flow.

The suffix '2' may be used to denote that the input current flows during some part of the cycle.

7.21 Class B Operation — The operation of an electron tube in such a way that the output current flows for approximately half of each electrical cycle when a pure sinusoidal input signal is used.

Note — The suffix '1' to 'B' may be used to denote that the input current does not flow.

The suffix '2' may be used to denote that the input current flows during some part of the cycle.

7.22 Class C Operation — The operation of an electron tube in such a way that the output current flows for appreciably less than half of each electrical cycle when a pure sinusoidal input signal is used.

Note — The suffix '1' to 'C' may be used to denote that the input current does not flow.

The suffix '2' may be used to denote that the input current flows during some part of the cycle.

7.23 Push-Pull Operation — The operation of two similar electron tubes, or of an equivalent double tube, in a circuit such that equal signal quantities in phase opposition are applied to the input electrodes and the two outputs are combined in a single circuit to reproduce the form of the original input signal.

7.24 Push-Push Operation — The operation of two similar electron tubes, or of an equivalent double tube, in a circuit such that equal signal quantities in phase opposition are applied to the input electrodes and the two outputs are combined in a single circuit to cancel the original fundamental input frequency. This facilitates frequency multiplication.

7.25 HT Warm-Up Time — The time interval between the start of application of the HT and the instant at which a stated value of one of the following characteristics is obtained:

a) Frequency,
b) Rate of drift of frequency,
c) Output power, and
d) Anode current.

7.26 HT Delay Time — The time interval between the instant at which a stated heater or filament voltage is reached and the instant at which the HT may be applied.

7.27 Total Starting Time — The time interval between the start of application of heater or filament voltage and the instant at which a stated value of one of the following characteristics is obtained;

a) Frequency,
b) Rate of drift of frequency,
c) Output power, and
d) Anode current.

7.28 Heater Warm-Up Time — The time required for the heater voltage to attain a stated fraction of its nominal value under stated conditions.

7.29 Cathode Preheating Time — The minimum period of time for which the heater or filament voltage should be applied before the application of electrode voltages.

7.30 Cathode Heating Rate — The time required for the rate of cathode current increase to reach its maximum value under stated conditions.

7.31 Cathode Heating Time — The time required for the cathode current to attain a stated fraction of its nominal value under stated conditions.

NOTE — The term 'cathode warming-up time' is sometimes used for carrying the same meaning.

7.32 Tube Starting Time — The period of time required for a stated parameter to attain a stated level under stated conditions.

7.33 Quiescent Balanced Operation — Balanced operation in which two similar electron tubes or of an equivalent double tube both operate under class B conditions.

7.34 Neutralization — The use of negative feedback in an amplifier in such a way as to neutralize the effect of an inherent positive feedback (such as the one arising from interelectrode capacitance).

7.35 Cathode Bias — The grid bias voltage derived by the fall of potential across a resistor included between the negative side of the source of anode current supply of an electron tube and the cathode terminal.

NOTE — Other terms carrying the same meaning are 'automatic bias' and 'self bias'.

7.36 Anode Feed Resistor — A resistor in a decoupling filter in the anode supply to an electron tube.

7.37 Cathode Follower Circuit — A circuit in which the output load is included in the cathode circuit of an electron tube and the input electron is applied between the grid and the remote end of the cathode load.

7.38 Parasitic Oscillations — Undesired oscillations, of frequency generally much higher than the intended operating frequencies, occurring in an electrode tube current.

7.39 Parasitic Suppressor — A device inserted into an electron tube circuit to reduce parasitic oscillations.

NOTE — The device is sometimes termed as 'grid stopper' or 'anode stopper' depending on its circuit location.

7.40 Grid Leak — A resistor which completes the direct current path between the grid and the cathode of an electron tube through grid bias, if any.

7.41 Interstage Coupling — The system used for transferring the output of one tube to the input of another.

7.42 Direct Coupling — A form of interstage coupling in which there is a direct current path from the output electrode of one tube to the input electrode of the succeeding tube.

7.43 Resistance-Capacitance Coupling — A form of coupling in which a tube having a resistance output load is connected to the input circuit of the next stage through a capacitor.

7.44 Choke (Inductance) Coupling — A form of coupling in which a tube having an inductor as output load is connected to the input circuit of the next stage through a capacitor.

7.45 Transformer Coupling — A form of coupling in which a tube has one of the windings of a transformer in its output circuit, the other winding being connected to the input circuit of the next stage.

7.46 Frequency Pulling — The phenomenon of the change in the frequency of oscillation with a change of load impedance.

7.47 Input Circuit — The external circuit connected to the input electrode of an electron tube and in which control voltage appears.

7.48 Output Circuit — The external circuit connected to the output electrode of an electron tube to provide the load impedance.

7.49 Transit Time — The time taken by a charged particle in moving between two stated points.

7.50 Transit Phase Angle — The product of the transit time and the angular frequency when the current resulting from a flow of electrons is sinusoidal.

7.51 Microphony — The modulation of one or more of the tube parameters resulting from mechanical or acoustical excitation.

7.52 Flicker Effect — The random variations of the output current in a tube with an oxide-coated cathode.

8. CONSTRUCTIONAL PARTS

8.1 Element — Any integral part of the tube that contributes to its operation and to which external connections can be made.

8.2 Electrode — A conducting element that performs one or more of the functions of emitting or collecting electrons or ions, or controlling their movement by an electric field.

8.3 Getter — A substance, within an electron tube, that decreases or stabilizes the internal gas pressure by chemical or physical action.

8.4 Heater — An electrically heated element for supplying heat to an indirectly heated cathode.

8.5 Heat Shield — A metal structure to reduce the heat radiation losses from a hot cathode or to protect other elements of the tube against heat radiation.

8.6 Cooling Fin — A metallic part of fin, extending the cooling area to facilitate dissipation of the heat generated in a tube.

8.7 Cathode - An electrode that is the source of the desired electron emission.

8.8 Cold Cathode — A cathode that does not require heating to produce the desired emission.

8.9 Hot Cathode — A cathode that shall be heated to produce the desired thermionic emission.

8.10 Directly Heated Cathode/Filament — A hot cathode, usually in the form of a wire or ribbon, that is heated directly by the passage of current through it.

8.11 Indirectly Heated Cathode — A hot cathode that does not carry the heating current.

8.12 Oxide-Coated Cathode/Oxide Cathode — A cathode consisting of a metal base coated with alkaline-earth oxides as the emissive material.

8.13 Dispenser Cathode — A cathode the emissive material of which is contained within a porous metal surface.

8.14 Thoriated Tungsten Cathode — A directly heated tungsten-filament cathode in which the emission is enhanced by addition of thorium.

8.15 Control Electrode — An electrode used to initiate or vary an electrode current.

8.16 Grid — An electrode having one or more apertures for the passage of electrons or ions.

NOTE — Where more than one grid is present in the same electron stream, it is customary to number them outwards from the cathode. Thus a grid occupying the *n*th position counting from the cathode is termed as 'grid number *n*'.

8.17 Control Grid — A control electrode in the form of a grid.

8.18 Screen Grid — A grid, located between a control grid and another electrode, to reduce the electrostatic influence of the electrode in the space between the screen grid and the cathode.

8.19 Shield Grid — A grid that shields the control electrode from electrostatic fields, thermal radiation and deposition of thermionic emissive material, and which may also be used as an additional control electrode.

8.20 Suppressor Grid — A grid, located between electrodes (usually the screen grid and the anode), intended primarily to prevent the passage of secondary electrons from one to the other.

8.21 Shield — A metallic electrode or coating used to shield the active electrodes (such as anode, grids, etc) from the influence of external and/or internal magnetic and electrostatic fields.

8.22 Input Electrode — An electrode to which the input signal is applied.

8.23 Output Electrode — An electrode from which the output signal is obtained.

8.24 Auxiliary Electrode — An electrode other than the cathode, anode, input or output electrodes.

8.25 Anode — An accelerating electrode that usually serves both as the output electrode and as the principal collector of electrons.

8.26 Envelope/Bulb — That part of an electron tube which forms gastight enclosure.

8.27 Tip — A small protuberance of the envelope resulting from the sealing of the envelope during evacuation.

8.28 Base — That part of an electron tube which carries the majority of pins and contacts used to connect the electrodes to the external circuit.

8.29 Socket — A separate device that provides electrical connections between pins of the tube base and the external wiring, keeping the tube easily removable; it may also provide mechanical retention of the tube and of a tube shield, if any.

8.30 Spigot — A projection on the base, usually cylindrical, that serves to locate the tube in the socket.

8.31 Key — A solid projection along length of the spigot that locates the base in its correct angular position in the socket.

8.32 Terminal — A conductor that serves to connect an electrode or element to its external circuit.

8.33 Pin — A rigid terminal that may also serve to locate and fix the tube in its socket.

8.34 Lead — A flexible terminal.

8.35 Cap — A terminal in the form of a metal shell mounted on the top or side of the envelope.

9. TUBE TYPES

9.1 Diode — An electron tube containing only an anode and a cathode.

9.2 Multi-electrode Tube — An electron tube containing more than two electrodes associated with a single electron stream.

9.3 Triode — A three-electrode electron tube containing an anode, a cathode and a control electrode, usually a grid.

9.4 Tetrode — A four-electrode electron tube containing an anode, a cathode, a control electrode and one additional electrode, usually a screen grid.

9.5 Pentode — A five-electrode electron tube containing an anode, a cathode, a control electrode and two additional electrodes, usually a screen grid and a suppressor grid.

9.6 Hexode — A six-electrode electron tube containing an anode, a cathode, a control electrode and three additional electrodes, ordinarily in the form of grids, one or more of which may be control electrodes.

Note — A common arrangement of a hexode comprises successively a cathode, a control grid, a screen grid, a second control grid, a second screen grid and an anode.

9.7 Heptode — A seven-electrode electron tube containing an anode, a cathode, a control electrode and four additional electrodes, ordinarily in the form of grids, one or more of which may be control electrodes.

Note — A common arrangement of a heptode comprises a hexode with an auxiliary anode between the first control grid and the first screen grid or with a suppressor grid between the second screen grid and the main anode. The term 'pentagrid tube' is sometimes used conveying the same meaning.

9.8 Multiple Tube — An electron tube containing within one envelope two or more units or groups of electrodes associated with independent electron streams, though sometimes with one or more common electrodes.

Examples:

Double diode, double triode, triode-heptode.

9.9 Double Tube — One form of multiple tube (*see* **9.8**).

9.10 Noise Generator Diode — A diode in which the wanted noise power is intentionally generated by shot effect, this noise power being a definite function of cathode current.

9.11 Ideal Noise Diode — A diode that has an infinite internal impedance and in which the current exhibits full shot-noise fluctuations.

9.12 Variable Mu Tube/Remote Cut-Off Tube — An electron tube so designed that the amplification factor, and therefore the mutual conductance can be varied over a wide range by means of a change in the operating point.

9.13 Sharp Cut-Off Tube — An electron tube so designed that the amplification factor and therefore the mutual conductance are nearly constant and not appreciably varied by a change in the operating point.

Note — From the operational characteristics, the cut-off point can be derived.

9.14 Aligned-Grid Tube — An electron tube in which the wires of at least two of the grids are substantially aligned so that one is in the shadow of the other.

9.15 Beam Power Tube — An aligned-grid tube in which the effects of secondary emission from the anode are suppressed by concentrating electron current into high density beams.

9.16 Mixer Tube — An electron tube which, when associated with an external oscillator, achieves frequency conversion.

9.17 Frequency Convertor Tube — An electron tube that contains both the mixer and local oscillator electrode systems required for frequency conversion.

9.18 Electrometer Tube — An electron tube designed to have a very high input impedance to allow detection, amplification and measurement of very small currents in circuits having a very high internal impedance.

10. MISCELLANEOUS

10.1 Activation — The treatment applied to a cathode in order to create or increase its emission.

INDEX

NOTE — This index has been prepared in accordance with IS : 1275-1958*. Index numbers are clause numbers.

A

- AC resistance
  - Anode 6.19
  - Electrode 6.8
- Activation 10.1
- Admittance
  - Electrode 6.4
  - Input 6.5
  - Output 6.6
- Aligned-grid tube 9.14
- Amplification factor 6.22
- Angle, Transit phase 7.50
- Anode 8.25
  - ac resistance 6.19
  - efficiency 6.18
  - feed resistor 7.36
  - stopper 7.39
  - supply power 5.22
  - voltage
    - Peak forward 5.24
    - Peak negative 5.25
- Anode-grid capacitance 6.27
- Automatic bias 7.35
- Auxiliary electrode 8.24

B

- Balanced operation, Quiescent 7.33
- Base 8.28
- Beam
  - power tube 9.15
  - tube, Electron 2.4
- Bias
  - Automatic 7.35
  - Cathode 7.35
  - Self 7.35
  - voltage, Grid 5.19
- Bulb 8.26

C

- Cap 8.35
- Capacitance
  - Anode-grid 6.27
  - Heater-cathode 6.29
  - Input 6.25
    - Effective 6.30
  - Interelectrode 6.16
  - Output 6.26
    - Effective 6.31
- Cathode
  - bias 7.35
  - Cold 8.8
  - current 5.16
  - Directly heated 8.10
  - Dispenser 8.13
  - follower circuit 7.37
  - heating
    - rate 7.30
    - time 7.31
  - Hot 8.9
  - Indirectly heated 8.11
  - interface layer 3.15
  - Oxide 8.12
  - Oxide-coated 8.12
  - preheating time 7.29
  - Thoriated tungsten 8.14
- Characteristic 7.1
  - Diode 7.8
  - Dynamic 7.3
  - Electrode 7.2
  - Mutual 7.5
  - Static 7.4
  - Transfer 7.5
- Charge, Space 3.16
  - static 3.17
- Choke coupling 7.44
- Circuit
  - Cathode follower 7.37
  - Input 7.47
  - Output 7.48
- Class A operation 7.19
- Class AB operation 7.20
- Class B operation 7.21
- Class C operation 7.22
- Cold
  - cathode 8.8
  - conditions 7.16
- Conditions
  - Cold 7.16
  - Hot 7.18
  - Operating 7.18
  - Standby 7.17
- Conductance
  - Electrode 6.10
  - Mutual 6.14

---

*Rules for making alphabetical indexes.

Contact potential difference 3.5
Control
  electrode 8.15
  grid 8.17
Conversion transconductance 6.15
Convertor tube, Frequency 9.17
Cooling fin 8.6
Coupling
  Choke 7.44
  Direct 7.42
  Inductance 7.44
  Interstage 7.41
  Resistance-capacitance 7.43
  Transformer 7.45
Current
  Cathode 5.16
  Electrode 5.3
    Inverse 5.5
    Reverse 5.5
  Emission 3.2
  Field-free emission 3.19
  Filament 5.9
  Filamentstarting 5.13
  Filament surge 5.13
  Gas 5.27
  Grid 5.17
  Heater 5.12
  Heater-cathode 5.15
  Heater-cathode insulation 5.15
  Heater starting 5.13
  Heater surge 5.13
  Leakage 5.14
  Load 5.29
  Quiescent 5.30
  Saturation 3.21
  Secondary electron emission 3.11
  Starting
    Filament 5.13
    Heater 5.13
  Surge
    Filament 5.13
    Heater 5.13
    of electrode 5.6
Curve, Operating 7.11
Cut-off
  tube
    Remote 9.12
    Sharp 9.13
  voltage 5.18

D

DC resistance, Electrode 6.9
Delay time, HT 7.26
Device, Electron 2.1
Diode 9.1
  characteristic 7.8
  Double 9.8
  Ideal noise 9.11
  Noise generator 9.10
  perveance 6.17
Direct coupling 7.42
Direction
  Forward 7.6
  Reverse 7.7
Directly heated cathode 8.10
Dispenser cathode 8.13
Dissipation, Electrode 5.4
Double
  diode 9.8
  triode 9.8
  tube 9.9
Driving power 5.21.1
Drop, Tube voltage 5.26
Duty factor 7.15
Dynamic characteristic 7.3

E

Effect
  Flicker 7.52
  Schottky 3.14
Effective
  input capacitance 6.30
  output capacitance 6.31
Efficiency
  Anode 6.18
  Thermionic emission 3.13
Electrode
  ac resistance 6.8
  admittance 6.4
  Auxiliary 8.24
  characteristic 7.2
  conductance 6.10
  Control 8.15
  current 5.3
    Inverse 5.5
    Reverse 5.5
  dc resistance 6.9
  dissipation 5.4
  impedance 6.1
  input 8.22
  material, Work function 3.4
  Output 8.23
  reactance 6.7
  Surge current of 5.6
  susceptance 6.11
  voltage 5.1
Electrometer tube 9.18
Electron
  beam tube 2.4
  device 2.1
  emission 3.1
  tube 2.2
Element 8.1

- Emission
  - characteristic of multi-electrode tube 7.8
  - current 3.2
    - Field-free 3.19
    - Secondary electron 3.11
  - Electron 3.1
  - factor, Secondary electron 3.12
  - Field 3.8
  - Photoelectric 3.7
  - Primary electron 3.9
  - Secondary electron 3.10
  - Specific 3.3
  - Thermionic 3.6
- Envelope 8.26

F

- Factor
  - Amplification 6.22
  - Duty 7.15
  - Gas content 6.20
  - Mu 6.21
  - Secondary electron emission 3.12
  - Vacuum 6.20
  - Voltage 6.21
- Field emission 3.8
- Field-free emission current 3.19
- Filament 8.10
  - current 5.9
  - starting current 5.13
  - surge current 5.13
  - voltage 5.8
- Fin, Cooling 8.6
- Flashover voltage 5.28
- Flicker effect 7.52
- Follower circuit, Cathode 7.37
- Forward
  - anode voltage, Peak 5.24
  - direction 7.6
- Frequency
  - convertor tube 9.17
  - pulling 7.46

G

- Gain
  - Incremental power 6.24
  - Power 6.23
- Gas
  - content factor 6.20
  - Current 5.27
  - filled tube 2.5
- Getter 8.3
- Grid 8.16
  - bias voltage 5.19
  - Control 8.17
  - current 5.17
  - input
    - power 5.21
    - voltage 5.20
  - leak 7.40
  - Screen 8.18
  - Shield 8.19
  - stopper 7.39
  - Suppressor 8.20
  - tube, Aligned 9.14
- Grid-to-grid capacitance 6.28

H

- Heated cathode
  - Directly 8.10
  - Indirectly 8.11
- Heater 8.4
  - current 5.12
  - starting current 5.13
  - surge current 5.13
  - voltage 5.10
  - warm-up time 7.28
- Heater-cathode
  - capacitance 6.29
  - current 5.15
  - insulation current 5.15
  - voltage 5.11
- Heating
  - rate, Cathode 7.30
  - time, Cathode 7.31
- Heat shield 8.5
- Heptode 9.7
- Hexode 9.6
- Hot
  - cathode 8.9
  - conditions 7.18
- HT
  - delay time 7.26
  - warm-up time 7.25

I

- Ideal noise diode 9.11
- Impedance
  - Electrode 6.1
  - Input 6.2
  - Load 7.10
  - Output 6.3
- Incremental power gain 6.24
- Inductance coupling 7.44
- Input
  - admittance 6.5
  - capacitance 6.25
    - Effective 6.30
  - circuit 7.47
  - electrode 8.22
  - impedance 6.2
  - power
    - Grid 5.21
    - RF 5.21.1

Input — *Contd*
  voltage, Grid 5.20
Instantaneous operating point 7.14
Insulation current, Heater-cathode 5.15
Interelectrode capacitance 6.16
Interface layer, Cathode 3.15
Interstage coupling 7.41
Inverse electrode current 5.5

K

Key 8.31

L

Layer, Cathode interface 3.15
Lead 8.34
Leakage current 5.14
Line
  Load 7.12
  Operating 7.11
Load 7.9
  current 5.29
  impedance 7.10
  line 7.12

M

Microphony 7.51
Mixer tube 9.16
Mu factor 6.21
Multi-electrode tube 9.2
  Emission characteristic 7.8
Multiple tube 9.8
Mutual
  characteristic 7.5
  conductance 6.14

N

Negative anode voltage, Peak 5.25
Neutralization 7.34
Noise
  diode, Ideal 9.11
  generator diode 9.10

O

Operating
  conditions 7.18
  curve 7.11
  line 7.11
  point 7.13
    Instantaneous 7.14
Operation
  Class A 7.19
  Class AB 7.20
  Class B 7.21
  Class C 7.22
  Push-pull 7.23
  Push-push 7.24
  Quiescent balanced 7.33
Oscillations, Parasitic 7.38
Output
  admittance 6.6
  capacitance 6.26
    Effective 6.31
  circuit 7.48
  electrode 8.23
  impedance 6.3
  power 5.23
Oxide
  cathode 8.12
  coated cathode 8.12

P

Parasitic
  oscillations 7.38
  suppressor 7.39
Peak
  forward anode voltage 5.24
  negative anode voltage 5.25
Pentagrid tube 9.7
Pentode 9.5
Perveance, Diode 6.17
Phase angle, Transit 7.50
Photoelectric emission 3.7
Pin 8.33
Point
  Operating 7.13
    Instantaneous 7.14
  Working 7.13
Potential difference, Contact 3.5
Power
  Anode supply 5.22
  Driving 5.21.1
  gain 6.23
    Incremental 6.24
  Grid input 5.21
  Output 5.23
  RF input 5.21.1
  tube, Beam 9.15
Preheating time, Cathode 7.29
Primary electron emission 3.9
Pulling, Frequency 7.46
Push-pull operation 7.23
Push-push operation 7.24

Q

Quiescent
  balanced operation 7.33
  current 5.30

R

Rate, Cathode heating 7.30
Reactance, Electrode 6.7
Remote cut-off tube 9.12
Residual state 3.20
Resistance
  AC
    Anode 6.19
    Electrode 6.8
  DC
    Electrode 6.9
Resistance-capacitance coupling 7.43
Resistor, Anode feed 7.36
Reverse
  direction 7.7
  electrode current 5.5
RF input power 5.21.1

S

Saturation
  current 3.21
  state 3.18
  voltage 5.7
Schottky effect 3.14
Screen grid 8.18
Secondary electron emission 3.10
  current 3.11
  factor 3.12
Self bias 7.35
Sharp cut-off tube 9.13
Shield 8.21
  grid 8.19
  Heat 8.5
Socket 8.29
Space charge 3.16
  state 3.17
Specific emission 3.3
Spigot 8.30
Standby conditions 7.17
Starting
  current
    Filament 5.13
    Heater 5.13
  time
    Total 7.27
    Tube 7.32
State
  Residual 3.20
  Saturation 3.18
  Space charge 3.17
Static characteristic 7.4
Stopper
  Anode 7.39
  Grid 7.39
Supply
  power, Anode 5.22
  voltage 5.2
Suppressor
  grid 8.20
  Parasitic 7.39
Surge current
  Filament 5.13
  Heater 5.13
  of an electrode 5.6
Susceptance, Electrode 6.11

T

Terminal 8.32
Tetrode 9.4
Thermionic emission 3.6
  efficiency 3.13
Thoriated tungsten cathode 8.14
Time
  Cathode heating 7.31
  Cathode preheating 7.29
  Heater warm-up 7.28
  HT delay 7.26
  HT warm-up 7.25
  Total starting 7.27
  Transit 7.49
  Tube starting 7.32
Tip 8.27
Total starting time 7.27
Transadmittance 6.12
Transconductance 6.13
  Conversion 6.15
Transfer characteristic 7.5
Transformer coupling 7.45
Transit
  phase angle 7.50
  time 7.49
Triode 9.3
  Double 9.8
  heptode 9.8
Tube
  Aligned-grid 9.14
  Beam power 9.15
  Cut-off
    Remote 9.12
    Sharp 9.13
  Double 9.9
  Electrometer 9.18
  Electron 2.2
  Electron beam 2.4
  Frequency convertor 9.17
  Gas-filled 2.5
  Mixer 9.16
  Multi-electrode 9.2
  Multiple 9.8
  Pentagrid 9.7
  Remote cut-off 9.12

- Tube — *Contd*
  - Sharp cut-off 9.13
  - starting time 7.32
  - Vacuum 2.3
  - Variable mu 9.12
  - voltage drop 5.26
- Tungsten cathode, Thoriated 8.14

V

- Vacuum
  - factor 6.20
  - tube 2.3
- Variable mu tube 9.12
- Voltage
  - Cut-off 5.18
  - drop, Tube 5.26
  - Electrode 5.1
  - factor 6.21
  - Filament 5.8
  - Flashover 5.28
  - Grid bias 5.19
  - Grid input 5.20
  - Heater 5·10
  - Heater-cathode 5.11
  - Peak forward anode 5.24
  - Peak negative anode 5.25
  - Saturation 5.7
  - Supply 5.2

W

- Warm-up time
  - Heater 7.28
  - HT 7.25
- Work function of electrode material 3.4
- Working point 7.13

(*Continued from page* 2)

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INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure stress	pascal	Pa	1 Pa = 1 N/m^2

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